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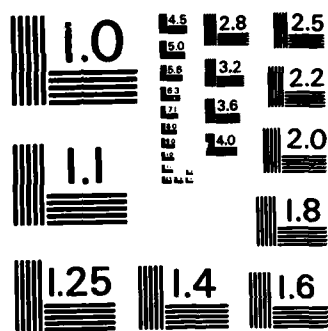
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SUFFIELD MEMORANDUM

NO. 1038

**A SPHYGMOMANOMETER CUFF CLAMP OR
SPHYGMOCLAMP (U)**

by

W.R. Dyck, B.J. Wenner and W.J. Fenrick

Project No. 13D10

June 1982

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ABSTRACT

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INTRODUCTION

There is considerable threat of chemical warfare (CW) operations in the event a conflict between NATO and Warsaw Pact Nations occurs. In such a confrontation, there would be casualties due to the use of chemical agents, and given the nature of CW protective ensembles and the continued requirement for their wearing, much difficulty would be encountered in establishing the diagnosis of nerve agent poisoning and assessing adequacy of therapy.

Trial CHACE (1) was conducted specifically to identify as many problem areas as possible with regard to casualty handling and casualty evacuation within a CW environment. The report makes the following conclusions:

"It was found extremely difficult to sort patients in protective ensembles into the appropriate evacuation priorities (triage) because of the difficulty of obtaining vital information such as pulse and blood pressure and the impossibility of open inspection of wounds in a contaminated environment."

"Methods of carrying out all types of medical treatment in the presence of chemical contamination require further investigation."

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"Many of the casualties in bags upon whom procedures were carried out in contaminated areas absorbed simulant. Trials are required to determine the extent to which the risk is increased by opening the bag to administer treatment."

The latter quote was included to point out that any procedures which could be carried out without opening the bag, would obviously reduce any further risk to the patient.

"Specific attention must be given to: a) Methods of reducing or eliminating the chemical risk to all types of casualties which arise from medical treatment procedures in a CW environment."

"There is a requirement for similar draft SOPs for CW operations at the UMS level and for procedures for first aid to non-chemical casualties during a chemical hazard."

"It is therefore considered that the following are required:
....a) Procedures for all types of first aid during and after a CW agent attack;"

A new device is described which will enable medical personnel to take blood pressures in a variety of scenarios which were difficult if not impossible before, without causing further risk of exposure to the patient.

CONCEPT OF USE

There are basically two methods of measuring blood pressure, the direct and the indirect method. The direct method involves catheterization of a major artery and taking direct and continuous readings of pressure, usually in a clinical environment. This method, however, is impractical in a field scenario. The indirect method requires a device called a sphygmomanometer which is found in almost every medical kit. An inflatable cuff, connected to a mercury manometer, is wrapped around the upper arm and the pressure in the cuff is raised to a point well above the systolic blood pressure. A stethoscope is placed over the brachial artery just below the lower edge of the cuff and the cuff is allowed to deflate slowly. The appearance, followed by the disappearance of the Korotkow sounds indicates systolic and diastolic blood pressure respectively. This method is widely used in the field but does require a cuff be placed around the upper arm.

The problem being addressed here is the case when the cuff cannot be placed around the arm. This case becomes more prevalent when considering non conventional warfare, because of the protective clothing worn, or protective devices a casualty is placed into. The prime example of such a case is when a casualty is in a CW casualty bag and the bag cannot be opened because by doing so, the casualty may be exposed to further risk if still within a CW environment.

The underlying principle in taking blood pressure is the ability to occlude an artery using a known pressure. Therefore, it is not necessary to wrap something (like a cuff) around the arm as long as enough pressure can be exerted against the artery to occlude it.

To overcome the problem of taking blood pressures through casualty bags, the following is offered as a solution. Add a sphygmomanometer cuff clamp, or sphygmoclap (Figure 1), to a standard sphygmomanometer already in the field, and combine that with an electronic stethoscope. The sphygmoclap is described in detail in the following section, and it is hoped that an electronic stethoscope, such as the one making up part of the Heart Rate Monitor (2) developed at DRES, will soon become standard equipment in the field. The cuff is folded and placed over the approximate vicinity of the brachial artery and the sphygmoclap secures it in place (Figure 2). When the clamp is closed over the cuff, the arm is virtually surrounded. The sphygmomanometer is functioned in a typical manner. The Korotkow sounds are detected with an electronic stethoscope, because the pulses must be detected through at least one layer of material, and systolic and diastolic pressures are read off the manometer.

Although being able to measure blood pressures through casualty bags is being used as the prime example, it should become obvious that by using the sphygmomanometer, sphygmoclap and Heart Rate Monitor together, other examples of obtaining blood pressures in difficult scenarios can be overcome. A situation may arise when a patient's clothing may not or can not be removed, e.g., CW coveralls in a CW environment, or a parka in a very cold

environment, or a pressurized suit or diving suit which cannot be removed quickly. The mere bulk of the clothing may prohibit placing a cuff 'around' the arm and certainly the layers of clothing necessitate an electronic stethoscope for auscultation. Although thigh cuffs are available, they are not always at hand. A normal sized brachial cuff may not physically fit around the thigh, and although the normal cuff isn't wide enough for an accurate femoral blood pressure, the sphygmoclamp can adapt it to the thigh for a ball park reading. In more remote examples when both arms are in slings, or in splints, or are splinted to the body, and a brachial blood pressure is desired, the sphygmoclamp could very likely make it possible.

DESCRIPTION OF THE SPHYGMOCLAMP

An assembly drawing of the sphygmomanometer cuff clamp or sphygmoclamp is shown in Annex A. The purpose of the clamp, as explained earlier, is to hold the cuff of a sphygmomanometer firmly against the upper arm of a patient in situations where the cuff cannot be wrapped around the arm. The cuff is folded and placed against the arm over the brachial artery and the clamp is attached so that it grips both the arm and the cuff. When the jaws of the clamp (1 and 2) are closed, the cuff is pressed firmly against the arm by the curved pressure plates (3 and 4). The curved pressure plates are made of 1/16" aluminum plate which is long enough to cover the cuff being used, i.e., 5" for a normal or regular adult cuff, 6" for a large adult cuff. When the cuff is inflated, the pawl (5) prevent the jaws from reopening.

The lower jaw (2) is made from a single thickness of 1/4" aluminum plate the perimeter of which includes a section where several ratchet teeth have been cut. The upper jaw is made of three separate pieces, a forward section (1) and two rear sections (6) which are bolted to the forward section in five different locations. The nuts and bolts in three of these positions (7) serve only to hold the upper jaw assembly together. A fourth bolt, identical to those used for part 7 passes through a stainless steel bushing (8) and serves not only to hold the assembly together, but also as a pivot about which the pawl (5) can rotate. To insure a free moving pawl the length of the bushing is specified to be 0.004" to 0.005" greater than the thickness of the aluminum plate from which the pawl is made. The pawl is forced against

the ratchet teeth on the lower jaw by a spring (9). The spring is anchored at the point 'A' where the end of the spring enters a hole in part (6). From the anchor point 'A' the spring is wrapped around a stud (10) and then bears against the upper portion of the pawl to force it against the teeth in the lower jaw.

As the upper and lower jaws move about their common pivot (11) in the direction 'B' and 'C', respectively, the ratchet and pawl combination prevents either jaw from reversing direction holding the pressure plates (3) and (4) firmly against the patient's arm. The pawl has been designed with a release lever which extends beyond the upper jaw assembly. The clamp is released by exerting a pressure 'D' on the lever which results in the disengagement of the pawl with the teeth. Two acorn nuts (14) have been placed on either end of a threaded rod (15) which is long enough to allow for a 3/8" diameter x 1/4" long spacer (16) on either side of the upper jaw assembly. With the added spaces, the acorn nuts not only hold the jaw assembly together but can also be used to facilitate easier opening of the jaws by pulling on them with the index and middle fingers when pressure 'D' is being exerted on the lever by the thumb.

TESTING THE DEVICE

Blood pressure was measured on each of 10 subjects under three different conditions with an approximate 10 minute interval between each measurement. The first measurement was made with the person in a casualty handling bag followed by a measurement while he was in a CW overgarment and finally a measurement on the bare arm as would be done under normal conditions. This sequence was chosen to assure an unbiased casualty bag reading. Each test was done with a regular adult cuff and also a large adult cuff to ascertain the advantages or disadvantages of one over the other. The tests were performed as follows:

1. Casualty bag

The subject was placed in a casualty handling bag in a supine position on a recovery stretcher and the unit was closed up. The man was then moved inside the bag so that he was as close as possible to one side of the bag. This would leave more slack on the opposite side which would allow

better access to the arm on which the measurement was to be taken. The arm was extended down the side with the palm facing upward.

Before applying the clamp, the pressure cuff was folded twice to form a pad approximately 5" x 5" with the inflation tubing on one external side (large adult cuff = 5" x 6").

The clamp was then applied to the upper arm such that the larger, fixed support was cradling the outer portion of the arm and the smaller, movable pad was positioned over the inner arm. The folded pressure cuff was then placed over the brachial artery and under the movable pad of the clamp with the bulb and manometer tubing on the portion against the arm. The clamp was then closed to secure the cuff against the arm. The tubing was connected to the manometer which was placed alongside and tilted to make readings more readily visible. The transducer of the Heart Rate Monitor was placed over the artery at the antecubital fossa. A small, loose sand bag (6" x 6" x 2" approximately) was placed over the transducer. This bag served to hold the transducer firmly in place. It also insulated the unit from external sounds and prevented movement artifacts which were present when it was held by hand.

The Heart Rate Monitor was turned on and the cuff was inflated to a pressure reading midway between the expected systolic/diastolic reading and a quick check was made for an audible arterial sound and the position of the transducer was adjusted as necessary. The pressure was increased to approximately 180 mm and then released to ascertain the systolic and diastolic readings after which the cuff was released and removed. After a 10 minute period, the above procedure was repeated with the large adult pressure cuff.

2. CW Overgarment

The subject was clothed in a CW overgarment and placed in a supine position on a recovery stretcher. The pressure cuff was wrapped around the covered arm in a normal fashion and the arm was extended along the body with the palm up. The transducer was placed over the artery at the antecubital fossa and covered with the sand bag. The same procedure as outlined under the previous test was followed to properly position the transducer and the blood pressure was read. After repeating the test with the larger cuff, the subject removed the CW overgarment.

3. Normal bare arm

The subject assumed a supine position on the stretcher with the arm extended, palm up, along the body. The pressure cuff and transducer were applied in a normal fashion on the bare arm. The method used in the above test was followed using both pressure cuffs. The results were tabulated showing the readings using the adult cuff and the large adult cuff on a person in a casualty handling bag, in a CW overgarment and under normal conditions.

RESULTS/CONCLUSIONS/RECOMMENDATIONS

The results of the tests described in the previous section are shown in Table I. The measurements taken show that the blood pressure readings of a casualty can be replicated, within biological variations, through a casualty bag, a CW overgarment, and a bare arm. The results also show that there is virtually no difference between reading taken with a regular cuff and a large cuff. It should also be noted, that during the entire test sequence, difficulty in obtaining a blood pressure reading occurred only once. The clamp was not properly positioned on the patient's upper arm and the artery was not occluded. However, with a minor adjustment of the clamp position, a reading was easily obtained.

It is concluded, that the measurement of blood pressure through a casualty bag or CW overgarment is not only possible but easy and simple too. It is therefore recommended that the Directorate of Preventive Medicine establish the number of sphygmoclamps required and implement procedures to outfit the groups identified to receive them.

REFERENCES

1. "Assessment of Casualty Handling in a Chemical Warfare Environment
'Trial CHACE' (Phase I)" DND Final Report on Trial 1/73 File No. 3472-8
30 September 1974. RESTRICTED.
2. Dyck, W.R. "Portable Digital Heart Rate Monitor (U)" Suffield Report
No. 286. June 1981. UNCLASSIFIED.



FIG. 1 SPHYGMOCLAMP



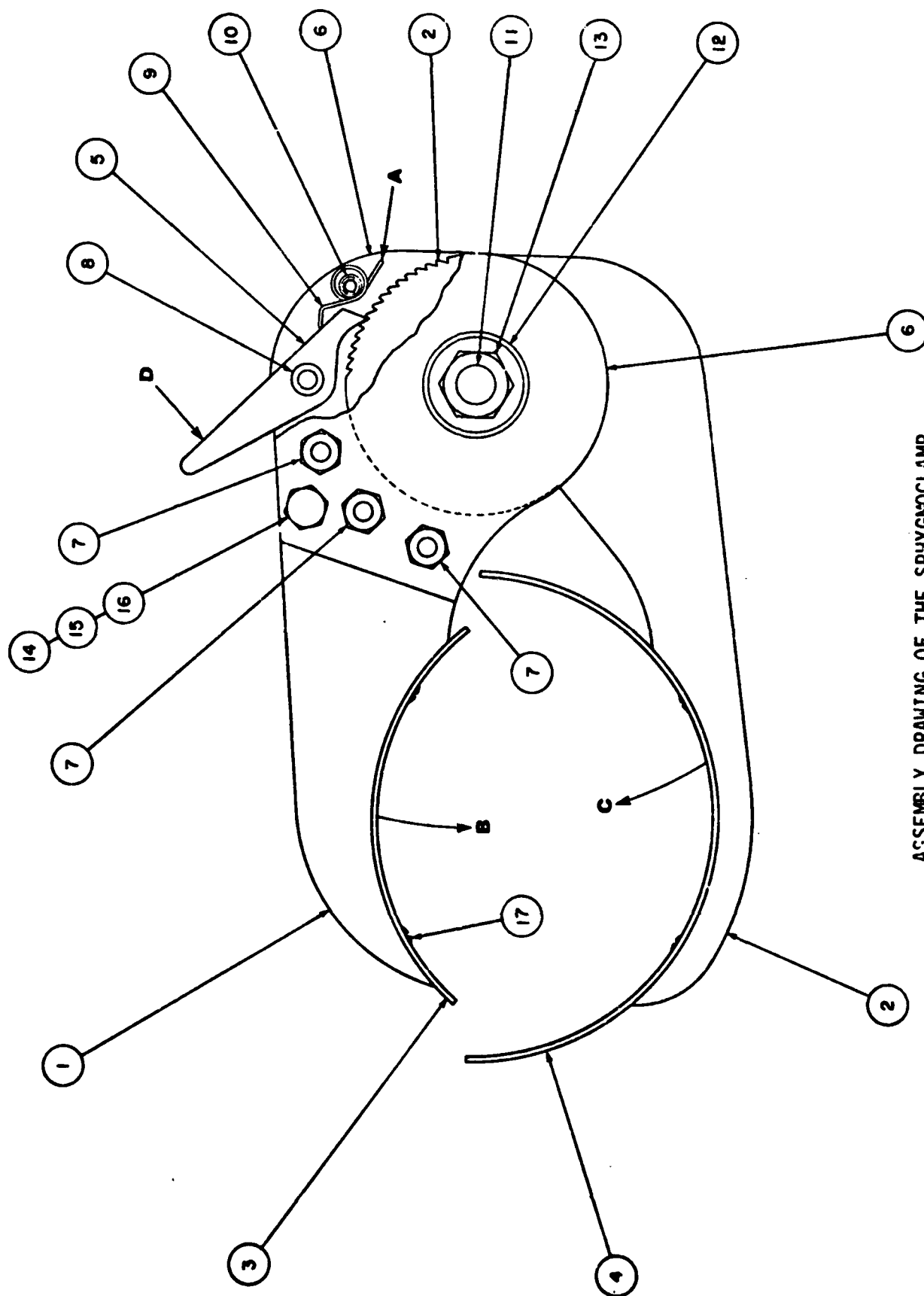
FIG. 2 SPHYMOCLAMP IN USE

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TABLE I
BLOOD PRESSURE MEASUREMENTS

<u>Subject</u>	<u>Through Bag</u>		<u>Through CW Suit</u>		<u>Bare Arm</u>	
	<u>Reg Cuff</u>	<u>Lge Cuff</u>	<u>Reg Cuff</u>	<u>Lge Cuff</u>	<u>Reg Cuff</u>	<u>Lge Cuff</u>
1	139/80	138/84	142/80	136/80	135/84	---
2	119/86	118/90	118/85	118/88	119/89	---
3	118/92	120/90	120/90	118/85	122/85	---
4	150/80	148/75	155/84	158/82	155/84	---
5	135/90	135/88	142/82	140/92	146/88	---
6	135/80	128/80	140/80	138/80	138/82	---
7	128/78	122/78	120/80	118/76	118/74	---
8	138/94	138/90	138/96	140/94	138/92	---
9	118/70	114/68	130/80	126/78	122/70	---
10	110/68	106/66	122/72	120/72	118/68	---

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ASSEMBLY DRAWING OF THE SPHYGMOCLAMP

ANNEX A-2
to SM 1038

Part No.	Description	# Req.	Material
1	Upper Jaw	1	1/4" aluminum (6061)
2	Lower Jaw	1	1/4" aluminum (6061)
3	Upper Pressure Plate	1	14 gauge aluminum
4	Lower Pressure Plate	1	14 gauge aluminum
5	Pawl	1	1/4" aluminum (6061)
6	Rear Section of Upper Jaw	2	1/4" aluminum (6061)
7	1/4" x 20 x 1" Bolts c/w Nuts	4	Cadmium plated steel
8	Stainless Steel Bushing	1	316 stainless
9	Pawl Pressure Spring	1	22 gauge steel piano wire
10	1/4" dia. Stud (Shoulder Screw)	1	316 stainless
11	Jaw Pivot	1	316 stainless
12	Jaw Pivot Washer	1	316 stainless
13	Jaw Pivot Nut	1	316 stainless
14	1/4" x 20 Achorn Nuts	2	Nickle plated brass
15	1/4" x 20 Threader Rod	1	316 stainless
16	Spacer 3/8" OD x 1/4" long	2	316 stainless
17	Pressure Plate Fasteners	4	4x40x1/4 oval head (18.8) stainless steel

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KEY WORDS

SPHYGMOCLAMP
SPHYGMOMANOMETER
HEART RATE MONITOR
BLOOD PRESSURE
CASUALTY BAG

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